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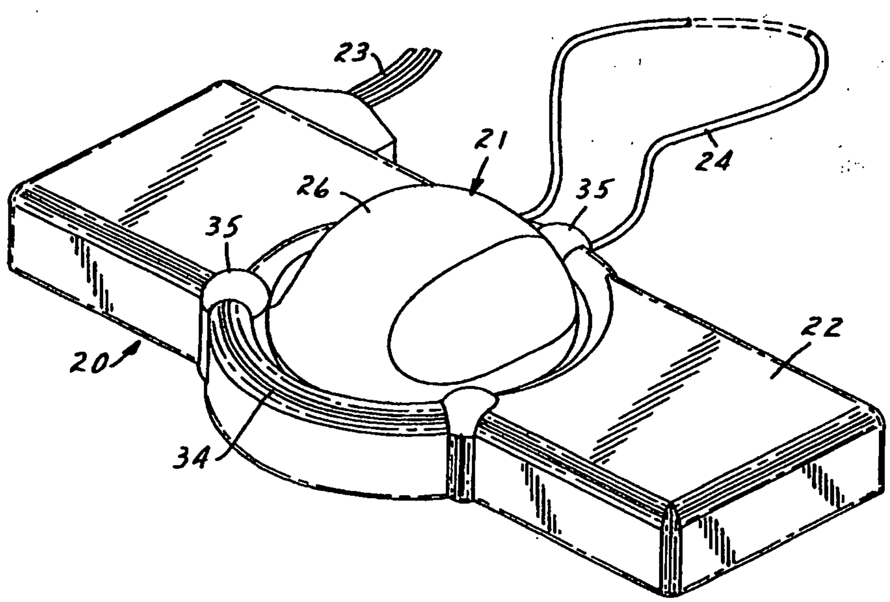

(57) Abstract

Data transfert apparatus comprises a hand-positionable unit (21), electrically-connected by a flexible electrical lead (24) to an interface device (22). The unit (21) is located on the top of an electronic device to receive recorded data transmitted from the device in the form of pulses of optical electromagnetic radiation (specifically infrared radiation). The data is then transferred by the interface device (22) to one or more external devices, for example a computer or a printer. When not in use, the hand-positionable unit (21) is stowed on a seat (34) on the interface device (22).

DATA TRANSFER APPARATUS FOR AN ELECTRONIC DEVICE

The present invention relates to data transfer apparatus for an electronic device, more especially, a self-contained electronic device.

The invention is concerned, generally, with the transfer of data to or from an electronic device by means other than via electrical wiring and relates, more especially, to the transfer of data in the form of optical electromagnetic radiation (ultraviolet, visible and infrared radiation).

The invention is particularly applicable to the transfer of data over comparatively short distances to, or from, an electronic device located in a sealed, enclosed system which makes the use of wired, electrical connections to the device impractical or even impossible.

One example of an electronic device from which data is transferred in the form of optical electromagnetic radiation is a test pack for determining the efficacy of a sterilization cycle in a sterilizer as described in US-A-5 565 634. Such a test pack is located within a sterilization chamber for the duration of a sterilization cycle and, at the end of the cycle, indicates whether or not the cycle has been effective. The test pack also records data relating to environmental conditions within the sterilization chamber and the transfer of that data from the test pack to outside hardware for analysis and/or documentation is preferably accomplished using infrared radiation transmitted through the housing of the device. In that way, the need to be able to connect the test pack (which is a sealed and self-contained unit) to external electrical wiring is avoided.

It is desirable, from the point of view of a user, that the optical transfer of data to/from an electronic device in such circumstances should be as simple as possible to carry out.

The present invention provides apparatus for sending/receiving data transmitted in the form of optical radiation signals to/from an electronic device and for transferring the data from/to at least one external device, the apparatus comprising a hand-positionable unit shaped to be located on the electronic device to send/receive the transmitted data, and an interface device for interfacing to at least one external device; the hand-held unit being electrically-connected to the interface device by a flexible electrical lead permitting the hand-held unit to be located on the electronic device at a distance from the interface device. In an embodiment of the invention, the hand-positionable unit includes at least one optical radiation sensor positioned to receive optical radiation signals transmitted from the electronic device.

By way of example only, embodiments of the invention will be described with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of an electronic device;

Fig. 2 is a perspective view of the device of Fig. 1 provided with a protective framework;

Fig. 3 is a perspective view of apparatus for use in transferring data to/from the electronic device of Fig 2;

Fig. 4 is a view similar to Fig. 3 but shows the hand unit of the apparatus lifted away from the remainder of the apparatus;

Fig. 5 shows the electronic device as in Fig. 2, with the hand unit of Fig. 4 about to be placed in position on top of the framework;

Fig. 6 is similar to Fig. 5 but shows the hand unit in position on top of the framework; and

Fig. 7 is a diagram illustrating the function of the data transfer apparatus of Fig. 3.

The device 1 shown in Fig. 1 is a test pack for use in determining the efficacy of a sterilization cycle in the sterilization chamber of a porous-load sterilizer. The test pack is intended to be placed inside the sterilization chamber and to remain there throughout a sterilization cycle, during which time it monitors and records environmental conditions within the chamber so that, at the end of the

cycle, a determination can be made as to whether or not the cycle was effective. The test pack has a cylindrical housing 2 within which are contained the components, including electronic components, necessary for the functioning of the device.

A detailed description of the method of operation and the internal construction of the test pack 1 are not essential for an understanding of the present invention but the test pack may, for example, incorporate some form of challenge load for challenging the penetration of sterilant through an opening (not visible) in the lower end of the housing 2 to a particular location within the housing. The sterilization cycle of a porous-load sterilizer typically commences with an air removal phase, to remove air from the sterilization chamber (including the load that is being sterilized) before the sterilant is applied, and the challenge load of the test pack 1 is so constructed that sterilant will be unable to reach the selected location within the housing 2 during a sterilization cycle unless that air removal phase has been effective. By providing sensors within the test pack for determining the presence/absence of sterilant at the selected location, the efficacy of the sterilization cycle can be determined. A test pack of that type, which uses temperature sensors to determine the penetration of sterilant within a challenge load, is described in US-A-5 565 634. That document also describes how the test pack may include an electronic memory for recording the information from the temperature sensors, and a microprocessor for determining, on the basis of that information, if a sterilization cycle has been effective. US-A-5 565 634 further describes how the test pack may give a visual indication, at the end of a sterilization cycle, of whether or not the cycle has been effective (e.g. through the use of an LED which will emit light to indicate that a cycle has been satisfactory) and also how, when the test pack has been removed from the sterilization chamber, recorded information about a sterilization cycle may be transferred from the test pack to outside hardware for further analysis and/or documentation. In particular, US-A-5 565 634 (the entire contents of which are herein incorporated by reference) describes that the information is transferred in the form of pulses of infrared radiation generated by an infrared LED within the test pack and transmitted through a window in

the housing of the test pack. The housing 2 of the test pack 1 includes such a data transmission window, indicated by the reference 3, in its upper end face 4.

To ensure that the test pack 1 is adequately protected against impacts, it is provided with a protective framework 10 as illustrated in Fig. 2. The framework also facilitates the handling of the test pack during use.

The framework 10 comprises two rings 11, 12 and three arms 13. The ring 11 has a diameter slightly greater than the diameter of the cylindrical housing 2 and is located adjacent and slightly above the upper end of the test pack 1 (i.e. the end at which the data transmission window 3 is provided). The ring 12 is of larger diameter than the ring 11 and is located adjacent and slightly below the lower end of the test pack (i.e. the end in which the access opening to the sterilant challenge load is provided). The arms 13 extend between the rings 11, 12 at equi-spaced locations around the test pack and are bowed outwardly so that, throughout their length, they are spaced apart from the test pack housing 2. The framework 10 is mounted on the test pack by connecting members 14, 15 which extend inwards to the housing 2 from the upper and lower ends respectively of the arms 13.

The ring 12 at the lower end of the framework 10 provides a base on which the framework, and hence the test pack 1, can stand. The lower end of the test pack 1 is then located slightly above the supporting surface, as can be seen from Fig. 2, thus allowing access for sterilant to the challenge load opening in the lower end of the test pack. In addition, the data transmission window 3 in the upper end face 4 of the test pack is clearly visible.

Each of the rings 11, 12 and the arms 13 comprises an inner reinforcing member formed from a material suitable for imparting sufficient rigidity and strength to the rings, for example a metal or rigid plastics material capable of withstanding the environmental conditions encountered in a sterilizer. The whole of the frame is covered by a softer, resilient material also capable of

withstanding the environmental conditions encountered in a sterilizer, for example silicone rubber.

The framework 10 is a rigid and strong construction which forms a buffer zone around the test pack 1 and will take up and absorb impacts which might otherwise damage components within the test pack. In addition, the arms 13 of the framework facilitate the handling of the test pack, particularly when it is being placed in, and removed from, a sterilization chamber and also when data is being read-out as described below. The framework 10 also provides a stand for the test pack 1, ensuring that it will be stood upright (as shown in Fig. 2) with the data transmission window 3 at the top. In that position, the data transmission window is unobstructed and accessible through the centre of the framework ring 11.

Further details of the construction of the framework 10 are not essential for an understanding of the present invention but, if desired, can be obtained from our co-pending application filed on the same day as the present application and entitled "Electronic device having a protective framework" (Case GEW 701 MED, Attorney Docket No. 53160UNK3A).

To transfer data from the test pack 1 when it has been removed from a sterilization chamber, the apparatus 20 shown in Figs. 3 and 4 is provided to receive the infrared radiation transmitted from the test pack through the data transmission window 3 and to transfer the data to external devices, for example a microprocessor or a printer. The data transfer apparatus 20 comprises a hand-positionable unit 21 for receiving infrared radiation directly from the test pack 1 and connected to an interface device 22 which, in turn, has connections 23 to external devices (not shown). The connection between the hand-positionable unit 21 and the interface device 22 is a conventional, external, wired electrical connection in the form of a flexible cable 24, advantageously a coiled cable.

The hand-positionable unit 21 has a circular base 25 on top of which is a hand grip 26. The dimensions of the circular base 25 are such that it can be placed,

through the centre of the ring 11 of the framework 10 of the test pack 1, onto the top of the test pack where it will sit on an upstanding collar 27 which surrounds the top face 4 of the test pack and will cover the data transmission window 3. When so located, an infrared sensor in the base 25 of the unit 21 will be able to receive data transmitted in a binary stream through the window 3 of the test pack 1, as described in greater detail below. Fig. 5 shows the hand-positionable unit 21 about to be placed through the ring 11 of the framework 10, and Fig. 6 shows the unit in position on the top of the test pack 1.

The shaping of the top of the framework 10 is designed to assist the user in positioning the hand-positionable unit 21 on the top of the test pack 1. In particular, it will be noted that the upper ends 28 of the three arms 13 of the framework are rounded and that the rounded surfaces project into the inside of the ring 11. The base 25 of the hand unit 21 fits just inside those rounded surfaces and will be guided by them into position on the top of the test pack 1. The rounded surfaces thus eliminate any necessity for the user to position the hand unit accurately on the test pack.

Fig. 7 illustrates, diagrammatically, the hand unit 21 seated on the top of the upstanding collar 27 of the test pack 1. It also indicates, diagrammatically, an infrared light emitting diode (IR LED) 30 located within the test pack 1 and positioned to transmit data, in the form of pulses of infrared radiation, through the data transmission window 3. That data may, for example, represent environmental measurements recorded by the test pack 1 when it was located in a sterilization chamber and stored in the electronic memory of the test pack. Fig. 7 also indicates, diagrammatically, an infrared sensor 31 located within the hand unit 21 of the data transfer apparatus. The sensor 31 will detect the pulses of radiation emitted by the diode 30 and convert them into electrical signals which will be sent, via the cable 24 to the interface device 22 and transferred to one or more external devices. The diode 30 and sensor 31 may be of any suitable type, for example, those available under the trade designations SB2470-2 and SDP8602-3 respectively from Honeywell Inc. of Minneapolis,

Minnesota U.S.A. If there is only one diode 30 and one sensor 31, they can both be located on the longitudinal axis of the test pack 1, to avoid any need for the hand unit 21 to be placed on the test pack in a particular orientation. Alternatively, the diode 30 may be one which emits radiation over a comparatively wide angle so that it will be detected by the sensor 31 regardless of where it is actually positioned over the data transmission window 3 of the test pack. As a further alternative, a sufficient number of sensors may be used to ensure detection of radiation from the diode regardless of the orientation of the hand unit 21.

The hand unit 21 preferably also incorporates some means for initiating the transfer of data from within the test pack. In one arrangement, the test pack incorporates a magnetically-actuated switching device 32 (indicated diagrammatically in Fig. 7) which, when actuated, causes data to be transferred from the test pack memory and transmitted by the diode 30. Actuation of the switching device 32 is brought about by a magnet 33 in the hand unit 21 when the latter is placed on the top of the test pack . The magnet 33 is also indicated diagrammatically in Fig. 7 and, to ensure that actuation of the switching device 32 is independent of the orientation of the hand unit 21, the magnet preferably extends around a substantial part of the circumference of the base 25 of the unit. Alternatively, a plurality of magnets (equi-spaced around the base 25) could be employed. The magnetically-actuated switching device 32 is preferably a Reed switch but it could, alternatively, be a Hall-effect device or a magneto-resistive device. Data transmission from the test pack 1 could, however, be initiated in other ways including, for example, by light generated by a light emitting diode in the hand unit 21 and detected by a suitable sensor in the test pack.

It will be appreciated that, although data transmission from the test pack 1 is described above as being effected by pulses of infrared radiation, other forms of electromagnetic radiation could be used including, in particular, visible light.

Regardless of the form of radiation used for data transmission from the test pack 1, the latter may include an indicator (for example, a light emitting diode) positioned adjacent the window 3, to generate a visible indication at the end of a sterilization cycle, to tell the user immediately whether or not the sterilization cycle has been effective.

The cable 24 of the data transfer apparatus 20, being flexible and possibly also extendible, permits comparatively extensive movement of the hand-positionable unit 21 relative to the interface device 22 so that the unit 21 can be placed without difficulty on the top of the test pack 1. When not in use in receiving data from the test pack, the unit 21 can be placed on the interface device 22 in a circular seat 34 provided for that purpose in the upper surface of the device. It will be noted from Figs. 3 and 4 that the circular seat 34 is formed with three rounded protrusions 35 which mimic the rounded ends 28 of the arms 13 of the test pack framework 10, and likewise aid the placing of the unit 21 on the interface device 22.

It will be appreciated that the particular form of the test pack 1 shown in the drawings and described above is not essential. Data transfer apparatus as shown in Figs. 3 and 4 could be used with any other suitable forms of electronic devices which transfer information over comparatively short distances in the form of pulses of optical electromagnetic radiation.

CLAIMS

1. Apparatus for sending/receiving data transmitted in the form of optical radiation signals to/from an electronic device and for transferring the data from/to at least one external device, the apparatus comprising a hand-positionable unit shaped to be located on the electronic device to send/receive the transmitted data, and an interface device for interfacing to at least one external device; the hand-positionable unit being electrically- connected to the interface device by a flexible electrical lead permitting the hand-positionable unit to be located on the electronic device at a distance from the interface device.

2. Apparatus as claimed in claim 1, in which the electrical lead connecting the hand-positionable unit to the interface device is also extendible.

3. Apparatus as claimed in claim 1, in which the interface device is in the form of a stand for the hand-positionable unit, on which the hand-positionable unit can be located when not in use.

4. Apparatus as claimed in claim 1, in which the hand-positionable unit includes at least one optical radiation sensor positioned to receive optical radiation signals transmitted from the electronic device.

5. In combination with apparatus as claimed in claim 4, an electronic device which is operable to transmit data in the form of optical radiation signals, and on which the hand-positionable unit is locatable to receive transmitted data.

6. A combination as claimed in claim 5, in which the electronic device has a housing formed with a window through which the optical radiation is transmitted, the housing being shaped to locate the hand-positionable unit over the window.

7. A combination as claimed in claim 6, in which the electronic device is generally in the form of an upright cylinder and the said window is formed in the upper end face of the cylinder.

8. A combination as claimed in claim 7, in which operation of the sensor to receive optical radiation signals from the electronic device is independent of the rotation position of the hand-positionable unit in a plane parallel to the upper end face of the cylinder.

9. A combination as claimed in claim 5, in which the upper end of the electronic device is shaped to provide a seat for the hand-positionable unit of the data receiving apparatus.

10. A combination as claimed in claim 5, in which the electronic device is provided with an external framework which forms a stand for the device.

11. A combination as claimed in claim 10, in which the framework includes means for guiding the hand-positionable unit into position on the electronic device.

12. A combination as claimed in claim 5, in which the electronic device is a self-contained unit which can be placed within a sterilization chamber for testing the efficacy of a sterilization cycle.

13. A combination as claimed in claim 12, in which the electronic device comprises a sterilant challenging path for challenging the penetration of sterilant from outside the self-contained unit to a predetermined location within the unit, and electronic means operable to record data relating to a first environmental condition at that location and a second environmental condition within the sterilization chamber.

14. A method of transferring data from a self-contained electronic test pack for use in determining the efficacy of a sterilization cycle, the method including the steps of; providing apparatus comprising a hand-positionable unit shaped to be located on the test pack, and an interface device for interfacing to at least one external device; the hand-positionable unit being electrically-connected to the interface device by a flexible electrical lead permitting the hand-positionable unit to be located on the test pack at a distance from the interface device;

placing the hand-positionable unit on the test pack, and

transferring data from the test pack to the hand-positionable unit.

15. A method as claimed in claim 14, in which the data is transferred following removal of the test pack from the sterilization chamber of a sterilizer.

16. A method of determining the efficacy of a sterilization cycle in a sterilization chamber, including the steps of:

locating a self-contained electronic test pack in the sterilization chamber to record data associated with environmental conditions in the chamber during a sterilization cycle;

removing the test pack from the chamber at the end of the cycle;

and transferring data from the test pack by:

providing apparatus comprising a hand-positionable unit shaped to be located on the test pack, and an interface device for interfacing to at least one external device; the hand-positionable unit being electrically- connected to the interface device by a flexible electrical lead permitting the hand-positionable unit to be located on the test pack at a distance from the interface device;

placing the hand-positionable unit on the test pack, and

transferring data from the test pack to the hand-positionable unit.

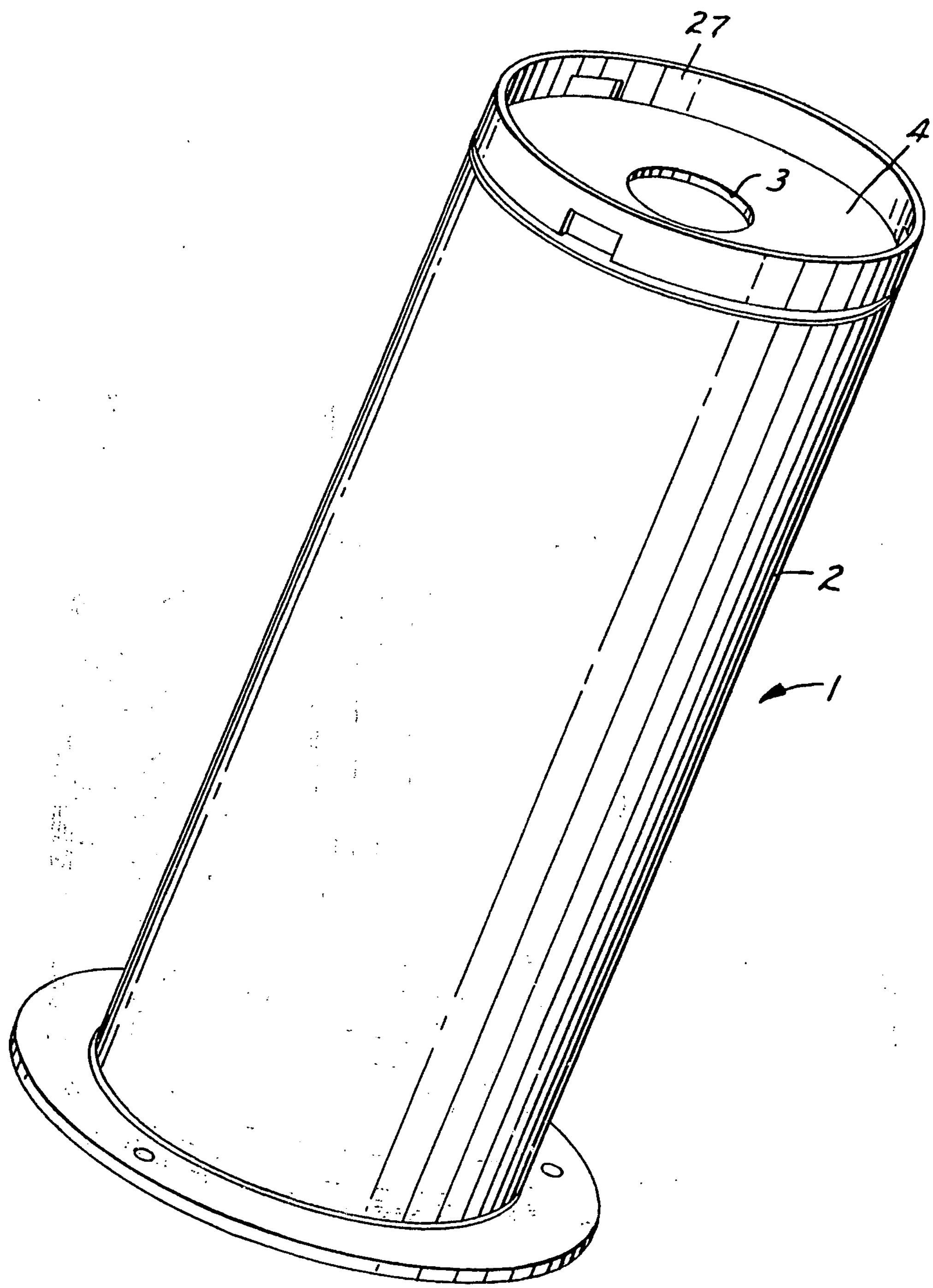

FIG. 1

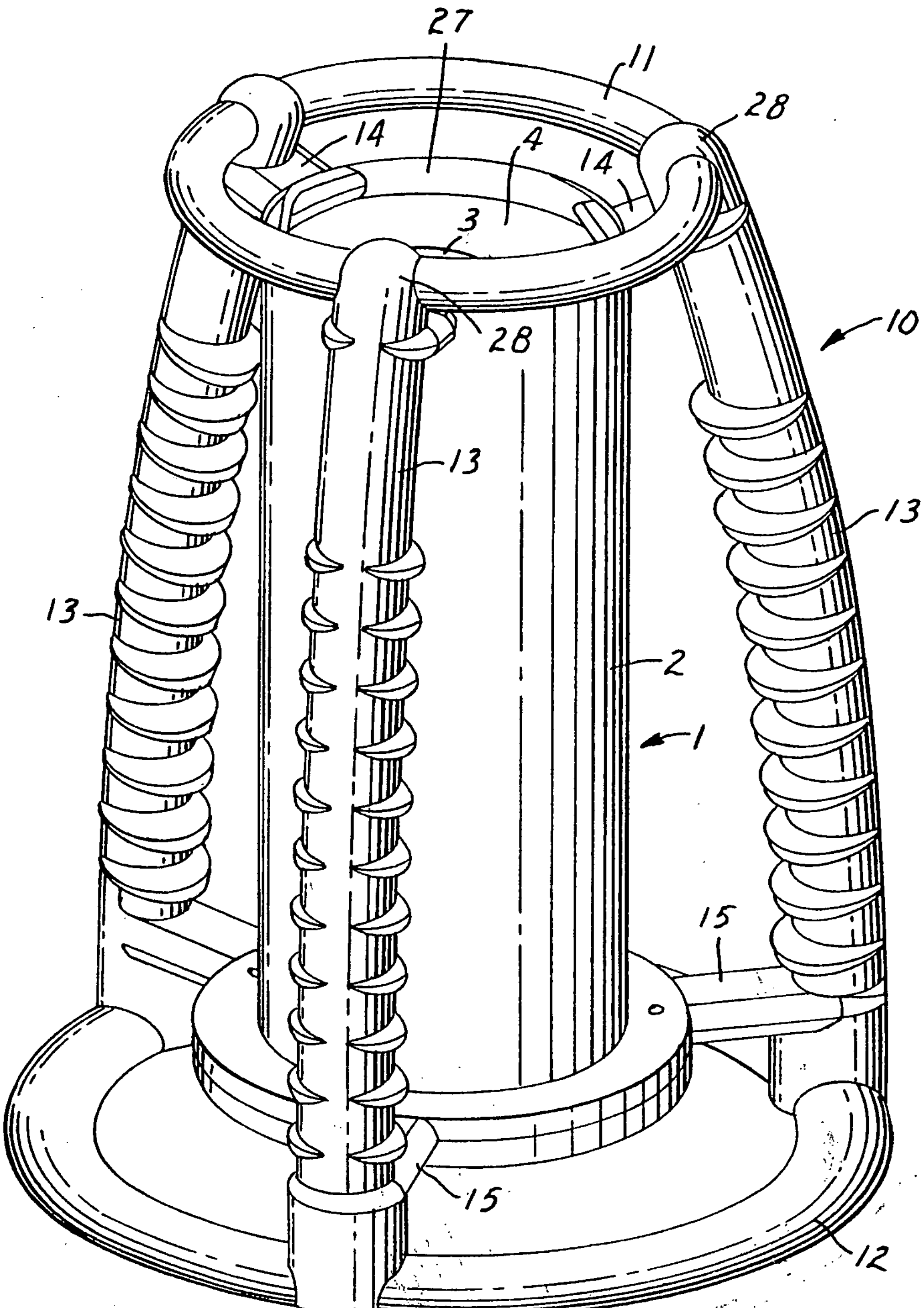

FIG. 2

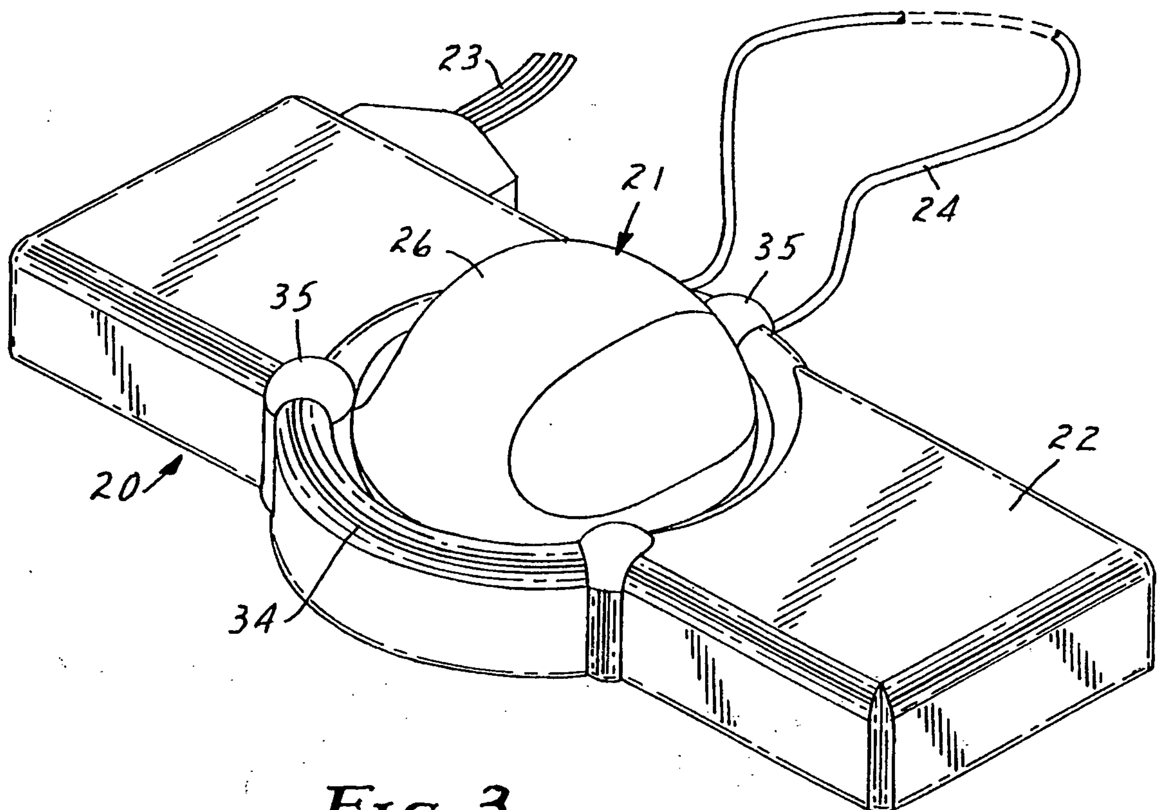

FIG. 3

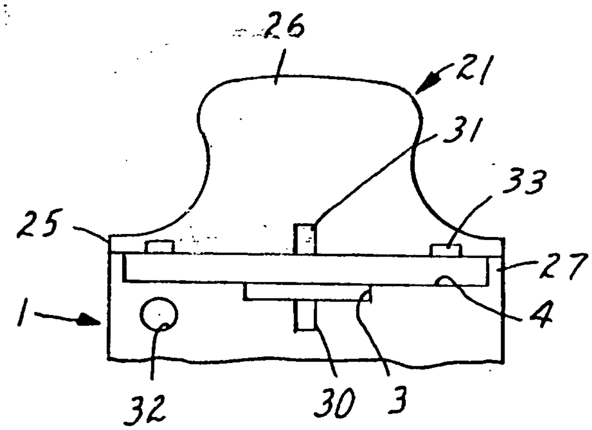

FIG. 7

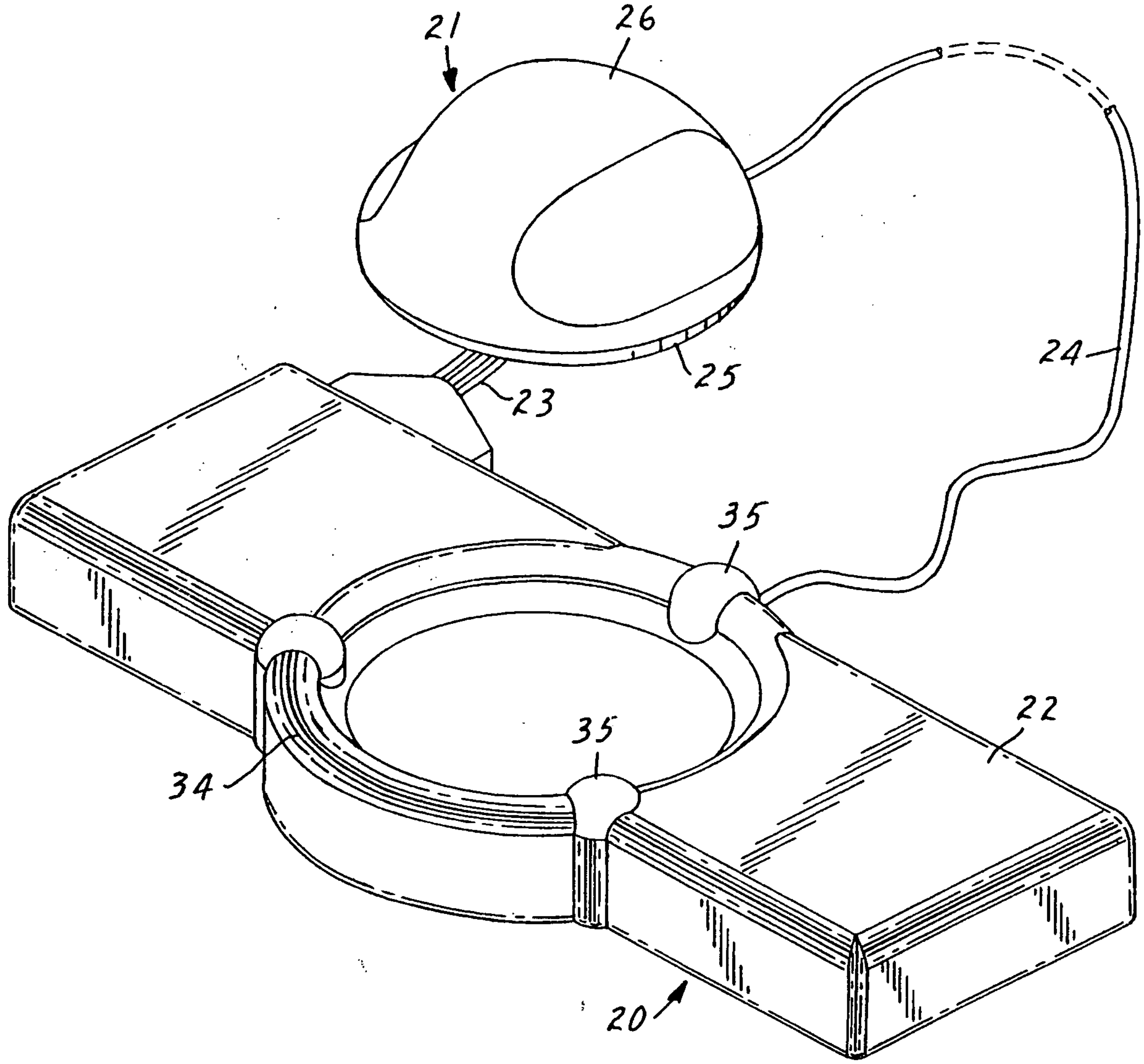

FIG. 4

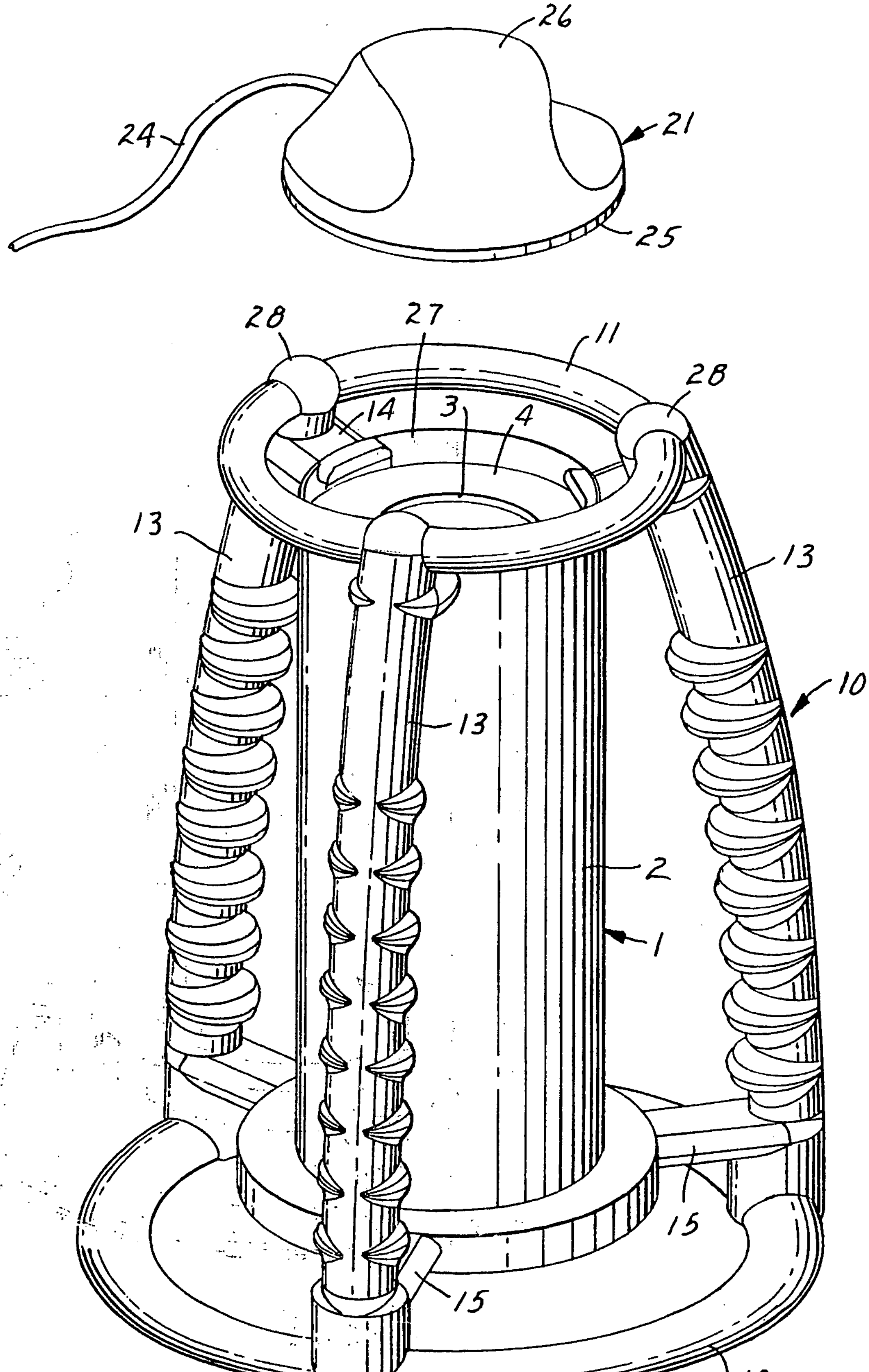

FIG. 5

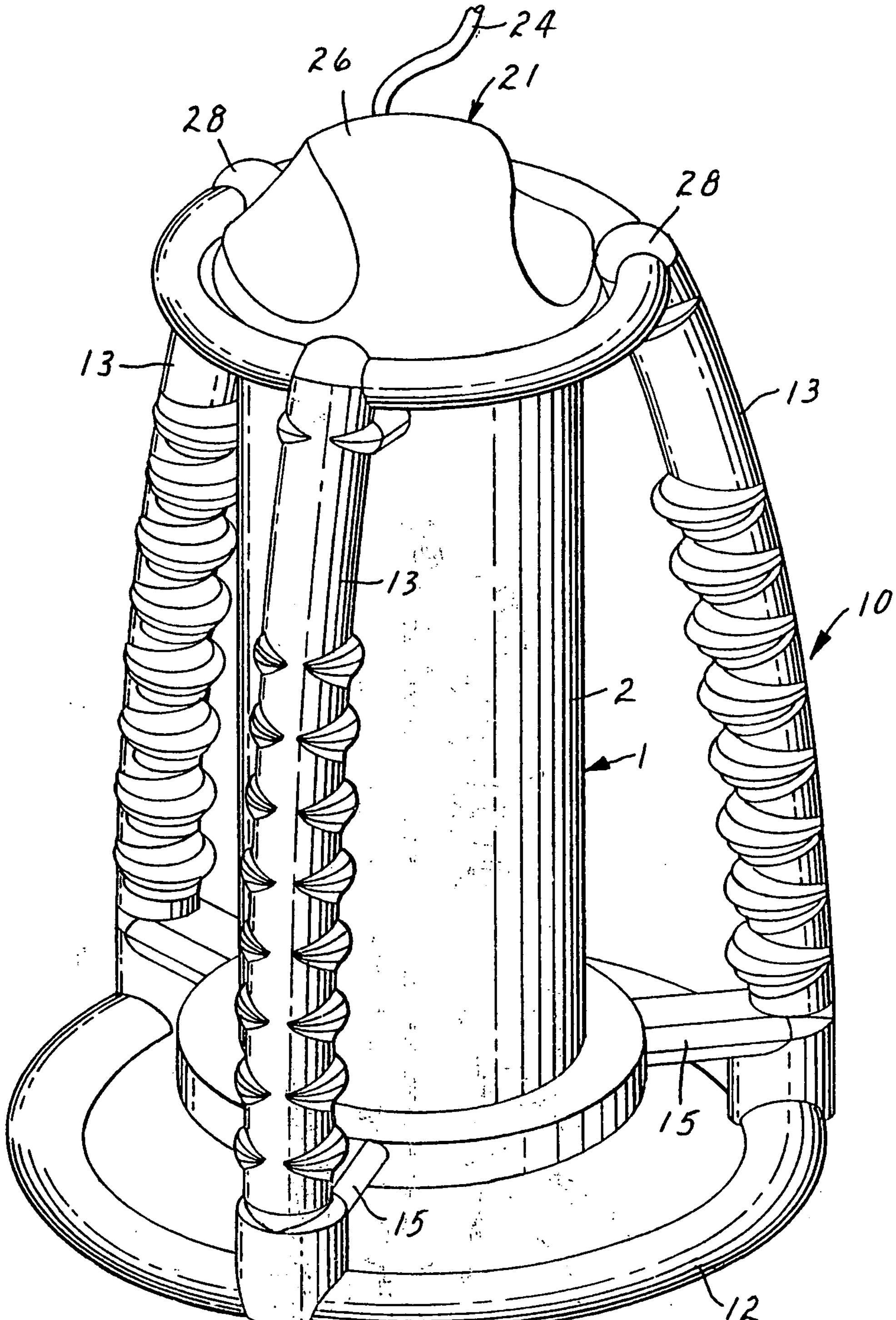

FIG.6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/01286

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04B10/10 A61L2/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04B A61L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 595 450 A (ELDEC CORP) 4 May 1994 see abstract see column 3, line 8 - line 21 see column 4, line 40 - line 43 see column 5, line 1 - line 16 see column 5, line 43 - line 50 see figures 1,2 ---	1,2,4-6, 9-11
X	EP 0 485 071 A (PETROLEO BRASILEIRO SA ;PONTIFICIA UNIVERSIDADE CATOLI (BR)) 13 May 1992 see abstract see figure 1 --- -/--	1,2,4-6, 9,10

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
27 April 1998	06/05/1998

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/01286

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	GB 2 312 800 A (NIPPON ELECTRIC CO) 5 November 1997 see abstract see page 1, line 8 - line 10 see page 6, line 9 - page 7, line 4 see page 8, line 2 - line 9 see figures 4,5	1-5
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A	US 5 565 634 A (GRAESSLE JOSEF A ET AL) 15 October 1996 cited in the application see abstract see column 10, line 24 - line 27 see figure 7	12-16

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 98/01286

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